

AN INVESTIGATION OF THE FUNCTIONAL RELATIONSHIP
BETWEEN FOOD ADDITIVES AND HYPERACTIVITY

By

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To Gail

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The presence of a functional relationship between the ingestion of artificial food colors and an increase in the frequency and/or duration of selected behaviors that are representative of the hyperactive behavior syndrome was experimentally investigated. Two eight year old females, who had been on the Feingold K-P diet for a minimum of 11 months, were the subjects of the study. The experimental design was a variation of the BAB design, with double blind conditions. This design allows an experimental analysis of the placebo phases as well as treatment phases. Data were obtained by trained observers on Out of Seat, On Task, and Physically Aggressive behaviors, as they occurred in the subjects' regular class setting.

Results of comparisons made across all treatment phases indicated (a) the existence of a functional relationship between the ingestion of artificial food colors and an increase in both

the duration and frequency of hyperactive behaviors, (b) a treatment effect that consistently lasted two days, (c) the absence of a placebo effect, and (d) differential sensitivity of the dependent measures to the treatment effects.

CHAPTER I

INTRODUCTION

The role of the diet in maintaining the physiological well being of the human body is fairly well understood. Questions, however, are often raised about the diet's effect on psychological or behavioral manifestations. Recently, Benjamin F. Feingold, emeritus director of the Laboratory of Medical Entomology of the Kaiser Foundation Research Institute, presented a theory that attributes the behavioral syndrome of hyperactivity to the ingestion of "salicylate-like" natural compounds in foods and artificial food flavors and colors.

As a treatment for hyperactivity, Feingold has prescribed the K-P diet, which eliminates a wide variety of natural and processed food, specifically those containing naturally occurring salicylates (found in many fruits) and all artificial flavors and colors. Feingold has made claims of dramatic improvements in patients who were treated with the K-P diet.

Because of the wide public interest aroused by the claim of Feingold and his advocates (Spring & Sandoval, 1976) and because of the public health implications of the diet, this study was proposed to determine if there is a functional relationship between the ingestion of artificial food additives and specific behaviors that are characteristic of the hyperactive behavioral syndrome.

Statement of the Problem

This study was designed to determine the existence of a functional relationship between the ingestion of artificial food colors and changes in the frequency or duration of specified behaviors, that are characteristic of the behavioral syndrome of hyperactivity, in elementary school aged hyperactive children.

Questions Under Investigation

This study was designed to answer the following questions regarding the influence of artificial food colors on the behavior of elementary school aged hyperactive children:

1. Is there a functional relationship between the ingestion of artificial food colors and the increased frequency of characteristic hyperactive behaviors?
2. Is there a functional relationship between the ingestion of artificial food colors and the increased duration of characteristic hyperactive behaviors?
3. How long is the time span during which behavior is affected by the ingestion of a single dose of an artificial food color?

Rationale of the Study

In 1973, Feingold presented a report at the annual meeting of the American Medical Association in which he proposed a theory

that purports to explain a cause of hyperactivity. He stated that hyperactivity was associated primarily with the ingestion of salicylates and common food additives. Feingold subsequently restated and expanded his position in a popular book titled Why Your Child Is Hyperactive (Feingold, 1975b).

Salicylate-like chemicals seem to produce allergic reactions (Lockey, 1971) and the mechanism of action of these chemicals seems to be through their coating of the organism's cell walls and then combining with its protein, thereby forming complexes which form antigenic potential, i.e., the process is nonimmunologic, so that the body has no natural defense against it (Feingold, 1975b; Lockey, 1971).

Salicylate-like chemicals are now incorporated in foods, beverages, and drugs as additives (Feingold, 1975a, 1975b, 1976; Lockey, 1971) and can cause a wide variety of hypersensitivity reactions (Lockey, 1971).

The medical literature shows that several conditions can be induced by the ingestion of food additives and dyes both in patients with aspirin hypersensitivity and without aspirin hypersensitivity. These conditions include asthma in the presence of aspirin hypersensitivity (Chafee & Settippene, 1967; Juhlin, Michaelsson, & Zetterstrom, 1972; Lockey, 1971; Szczeklik, Gryglewski, Czerniawska-Mysk, & Zmuda, 1976), asthma when aspirin hypersensitivity was not indicated (Hawley & Buckley, 1974), urticaria (Juhlin et al., 1972; Lockey, 1971), and various other allergic reactions, including flushing of the face, rhinorrhea, and eczematous dermatitis (Lockey, 1971).

Feingold (1973) noted that an adult patient with aspirin hypersensitivity showed remission of psychiatric disturbances when the patient was placed on the K-P diet. Because salicylates and food additives have produced similar behavioral reactions, Feingold has recommended treatment of hyperactive children with the K-P diet.

Many criticisms were immediately raised concerning Feingold's claims (Conners, 1975; Conners, Goyette, Southwick, Lees, & Andrulonis, 1976; Levine & Liden, 1976; Nutrition Foundation, 1976; Spring & Sandoval, 1976). Included among the criticisms are

1. The subjects were not described by any standard method, nomenclature, or measurements.
 2. No controls were used to compare changes against the Feingold group.
 3. No objective measures of change were used.
 4. Observers were not "blind" and may have had a vested interest.
 5. The alternative explanation of a placebo phenomenon was not considered.
 6. Claims of percentage of improvement varied from one presentation to another and no statistical procedures were ever employed.
- In short, claims were strictly impressionistic, anecdotal, and lacking in objective evidence.

In 1975, Conners undertook a double blind, controlled study to test the efficacy of the Feingold diet. In spite of some

rather impressive data that indicate statistical significance between both a placebo diet and Feingold's diet and a baseline period, Conners was faulted by the National Institute of Education (1975) for several methodological errors, including the following:

1. The study was not a test of effects of food additives per se, but rather a test of two diets.
2. A small sample size (N=15) was employed.
3. The study did not control or investigate order effects.
4. "Soft" behavioral outcome measures were used.
5. The experimenters failed to investigate the differential rating of behavior change as reported by teachers and parents.
6. The experimenters failed to establish reliability and validity of the ten item hyperkinesis index used as a measurement instrument.

Conners et al. (1976) recommend further research into the efficacy of the K-P diet and specifically call for a within-subject design, so that the child will be exposed to both the placebo and active treatments.

Given the above theoretical support in the literature and the methodological problems cited in previous reports, the present study will investigate Feingold's theory and, at the same time, control the above sources of methodological error.

Limitations

For at least two reasons, the subjects of this study cannot be said to represent adequately all hyperactive children. First,

there is great variability in definitions and diagnoses of the syndrome of hyperactive behavior. Second, the degree of severity of behavior has been reported as varying inversely with the age of the child.

Delimitation

The observed behaviors do not include all behaviors that are characteristic of the hyperactive behavior syndrome. For this reason, the dependent measures of this study cannot be considered to be representative of all hyperactive children.

Summary

Feingold's theory and the K-P diet have received wide attention, especially in the public sector. While the medical literature seems to offer theoretical support for Feingold's claims, there is currently a paucity of relevant research data regarding the K-P diet and its effect on the behavioral syndrome of hyperactivity. In Chapter I the reader was introduced to the problem area. In subsequent chapters the reader will find an elaboration on the related literature (Chapter II) and a description of the methodology of the present study (Chapter III). The data obtained in the present study are presented in Chapter IV. In Chapter V the reader will find a discussion of the data and the results of the study and recommendations for research that will further investigate the alleged functional relationship

between the ingestion of artificial food flavors and colors and the specified component behaviors of the hyperactive child.

CHAPTER II

REVIEW OF RELATED LITERATURE

Two major areas of literature directly related to this study are the description of the behavioral characteristics of the hyperactive child and the substantiation of Feingold's theory and its resultant K-P diet as a treatment for hyperactivity. The disciplines from which literature has been drawn include special education, nursing, medicine (i.e., allergy, nutrition, and pediatrics), and psychology.

The remainder of this chapter will examine the literature which is relevant to this study. First, literature dealing with the specific behaviors or behavioral categories of the hyperactive syndrome will be analyzed. Second, Feingold's theory and its relationship to hyperactivity will be examined. Included in this discussion will be the medical literature pertaining to allergic reactions to artificial food additives, criticisms of Feingold's theory, and studies that have attempted to determine the efficacy of Feingold's treatment approach (the K-P diet).

Hyperactive Behaviors

Task Force I, cosponsored by the National Society for Crippled Children and Adults and the National Institutes of

Neurological Diseases and Blindness of the National Institutes of Health (Clements, 1966) was primarily concerned with the development of a consensually agreed upon definition of learning disabilities. In addition, Task Force I attempted to describe the symptoms and signs by which such children could be identified. They systematically explored the literature of learning disabilities and assigned the various signs and symptoms to preliminary categories. Further distillation provided a list of the ten most frequently cited characteristics of the learning disabled population. Hyperactivity was listed first, as the most frequently cited characteristic. Clements (1966), as editor of Task Force I's report, defined hyperactivity as motor behavior which is not demanded by the situation or the task involved and which is disruptive to the group or to the expectations of the observers.

Marwit & Stenner (1972) write that there seems to be a consensus among professionals regarding certain behaviors associated with hyperactivity. Included in a list for which there seems to be substantial agreement are

1. Overactivity - constant motor activity which is greatly in excess of that of the more normal child, including an inability to stay seated (Dubey, 1976; Feingold, 1975a, 1976; Knobel, 1962; Laufer & Denhoff, 1957; Solomons, 1971; Stine, 1976).

2. Short attention span - child will seldom complete a task and frequently shifts from one activity to another (Dubey, 1976; Feingold, 1975a, 1976; Keogh, 1971; Knobel, 1962; Laufer & Denhoff, 1957; Solomons, 1971; Stine, 1976; Walker, 1975).

3. Low frustration tolerance - when frustrated the hyperactive child often reacts with explosive fits of anger (Feingold, 1975a, 1976; Keogh, 1971; Knobel, 1962; Stine, 1976; Walker, 1975).

4. Aggressiveness - the hyperactive child is often destructive and tends to bully peers (Feingold, 1975a, 1976; Laufer & Denhoff, 1957; Knobel, 1962).

Several other behavioral categories have been mentioned in the literature as being characteristic of the hyperactive child, including:

1. Impulsivity (Dubey, 1976; Feingold, 1975a, 1976; Laufer & Denhoff, 1957; Marwit & Stenner, 1972).

2. Distractibility (Keogh, 1971; Laufer & Denhoff, 1957; Marwit & Stenner, 1972; Stine, 1976).

3. An inability to delay gratification (Feingold, 1976; Knobel, 1962; Laufer & Denhoff, 1957).

4. Poor school performance (Feingold, 1976; Knobel, 1962; Laufer & Denhoff, 1957).

5. Irritability (Solomons, 1971).

6. Emotional lability (Stine, 1976).

7. Sleep disturbances (Feingold, 1975a, 1976; Walker, 1975).

For the purposes of this study, data have been collected on behaviors that are representative of the following substantially agreed upon behavioral categories: overactivity, short attention span, low frustration tolerance, and aggression.

Allergic Reactions to Salicylates

As mentioned in a previous chapter, low molecular weight chemicals, i.e., salicylates, seem to produce allergic reactions because of their immunologic properties (Feingold, 1975b; Lockey, 1971). Salicylates have, until recently, been most closely associated with aspirin which contains the acetyl compound of salicylic acid. Early in the 20th century, however, artificial food colors began to be derived from coal tar and the chemical analyses of these food colors reveal a structural similarity to other salicylate radicals (Feingold, 1975b; Chafee & Settupane, 1967). Shelley (1964) stated that aspirin sensitivity is truly salicylate sensitivity.

Several conditions have been shown to be induced by the ingestion of food additives and Lockey (1971) states that a wide variety of hypersensitivity reactions can be caused by these "hidden allergens."

Asthma

Speer (1958) reported that artificial colors were the cause of asthma in six children, but gave no further details. Several other authors have reported either inducing asthma by introducing additives or alleviating the symptoms of asthma by the removal of the additives. Shelley (1964), for example, has written that aspirin, with its salicylate content, is the only drug which commonly induces asthma.

Szczeklik, Gryglewski, Czerniawska-Mysk, and Zmuda (1976) reported three case studies of aspirin induced asthma. While

there was no degree of experimental control reported, Szczeklik et al. reported seemingly impressive clinical data that appeared to support their contention.

Chafee and Settippane (1967) reported the case study of a 42 year old female who was hospitalized with severe asthma. The subject had a prior history of aspirin sensitivity and had previously been advised to abstain from aspirin ingestion. Chafee and Settippane implemented a double-blind experimental condition that was used to challenge the subject with six FD&C approved dyes, with a subsequent positive reaction to yellow #5 and red #4. The most severe reaction was to yellow #5 and included tickling of the throat, tight cough, and wheezing for 24 hours. Lockey (1971) has reported three cases of asthma in children due to the ingestion of artificial food additives.

Juhlin, Michaelsson, and Zetterstrom (1972) reported a study with tight experimental controls, including a double-blind and a placebo. Their purpose was to test the effects of tartrazine (yellow #5) in aspirin sensitive patients, by administering oral doses of 1 mg. yellow #5 diluted in 10 to 20 ml. of distilled water. Juhlin et al. found that 7 of 8 subjects responded positively, including severe asthma (lasting as long as four days), severe urticaria (hives), and less severe symptoms, such as facial flushing.

Other Reactions

Various other reactions have been reported in the medical literature, although the frequency of occurrence of these reactions

seems to be much lower than for asthma. Shelley (1964) reported a case study of a six year old male who was initially hospitalized and treated for pustular psoriasis, with pustules over 80% of his body and a body temperature of 105° F. Aspirin sensitivity was discovered and, as a correlate, Shelley treated the subject with an elimination of artificial salicylates, in a controlled atmosphere, because the subject had demonstrated a reaction to air borne salicylates, e.g., birch pollen. Conditions such as flushing of the face, rhinorrhea, and eczematous dermatitis have also been reported (Lockey, 1971, 1973; Shelley, 1964).

Feingold's Theory

In June, 1973, Feingold presented an oral report at the annual meeting of the American Medical Association in which he stated that the behavioral syndrome of hyperactivity was associated primarily with the ingestion of "low molecular weight chemicals." Feingold included in this category salicylates and common food additives, especially artificial colors and flavors. Feingold has restated and expanded his position in various articles (1973, 1975a, 1976) and in a popular book titled Why Your Child is Hyperactive (Feingold, 1975b).

In his book, Feingold states his hypothesis as follows:

1. "The hyperactive disturbance is nonimmunologic. There is no natural body defense against it" (Feingold, 1975b, p. 166).
2. "Those children who react to the synthetic additives have genetic variations - not abnormalities - which predispose them to such adverse responses" (p. 166).

3. An "innate releasing mechanism is involved in the disturbance" (p. 166). This innate releasing mechanism (IRM) acts as a control on the flow of impulses from the automatic nerve centers to the "central nervous motor mechanisms." The IRM probably prevents "an excess of discharge into muscular active cells" (Feingold, 1975b, p. 165).

The treatment that Feingold suggests is dietary, and is based on an exclusion diet, wherein certain foods, food groups, or ingredient groups are eliminated from the patient's dietary intake. Seventeen fruits and vegetables are reported by Feingold as containing natural salicylates and must be omitted. In addition, all foods that contain artificial color and artificial flavor are prohibited. Feingold lists 54 foods as examples (1975b). (See Appendix A.)

The Feingold regimen prohibits not only certain foods, but also a wide variety of non-food items which contain the prohibited salicylate compounds (Feingold, 1975a, 1975b, 1976). Included among these items are many medications (both prescription and over the counter) and various sundry items, e.g., toothpastes, mouthwashes, perfumes, antacid tablets, and cough drops.

Criticisms of Feingold's Theory

The Nutrition Foundation assembled 14 food, medical, and behavioral scientists, designated as the National Advisory Committee on Hyperkinesis and Food Additives, to examine the evidence on Feingold's theory. The committee had the following responsibilities:

(a) review critically and objectively the evidence relative to the hypothesized relationship; (b) recommend whether future investigations were justified; and (c) provide guidelines regarding the experimental design of future studies (Nutrition Foundation, 1976).

The committee's conclusions can be summarized as follows (Nutrition Foundation, 1976):

1. No controlled studies have demonstrated the relationship between the ingestion of food additives and hyperactivity.
2. The claim of significant behavioral improvement after treatment by a salicylate and food additive free diet has not been confirmed.
3. The nutritional qualities of the K-P diet have not been thoroughly evaluated. Therefore, the possibility exists that the diet may not meet the long-term nutritional needs of children.
4. The diet should be considered experimental, and, as such, should only be used with medical supervision.

The committee's conclusions implicitly contain recommendations for future research.

Clinical Studies of the Efficacy of the K-P Diet

Several uncontrolled clinical studies have been presented, often in the form of case studies, which attempted to establish the efficacy of the K-P diet as a treatment for hyperactivity.

In 1965, Feingold treated an adult female who was suffering from acute hives. She was placed on an elimination diet which

omitted salicylates from her diet. Not only did the hives heal, but previously unreported psychiatric symptoms, i.e., aggression and hostility, also cleared in less than two weeks (Feingold, 1973, 1975b). This clinical study was the first reported by Feingold, but many other anecdotal reports quickly followed and many of these are included in Feingold's book (1975b). For example, 11 children aged three years to 17 years, were placed on the K-P diet on May 13, 1974, in Redwood Valley, California. "Each of the eleven children had behavior or learning difficulties" (p. 151). After two weeks of strict food control, with the K-P diet as the only variable, six children had "responded favorably to dietary management and two showed suggestive responses" (p. 151).

Twenty-five children were included in a demonstration program in Santa Cruz, California, in 1974. Sixteen of the 25 were reported as demonstrating at least a favorable response to the K-P diet (Feingold, 1975b; Hyperactivity, 1975).

Feingold (1975a) has reported the results of five unidentified studies which involved a total of 194 children. Of these 194 children, 93 or 48% had a favorable response to diets that eliminated artificial flavors, colors, and natural salicylates. The range of percent of favorable responses for the above five studies was 40% to 73%.

Stine (1976) presented two case reports of hyperactive pre-school boys who were treated with the K-P diet. The first boy was referred at 5 years 6 months, with a reported history of hyperactivity, distractibility, and delayed speech development. Stimulant medication was discontinued because of the regular

onset of headaches, vomiting, and anorexia that all occurred within 20 minutes after drug ingestion. The boy obtained a mental age of three years nine months (IQ 70) on the Binet Intelligence Scale. His developmental milestones were reported as having occurred normally. The boy was subsequently placed on the K-P diet as a treatment of last resort. Behavioral improvement was gradual and within five months his behavior was characterized by such statements as "maintaining eye contact," "markedly less distractible," and could "accept verbal discipline" (P. 641).

The second case reported by Stine (1976) was a four year old boy who was referred for persistent and severe behavior problems and hyperactivity, which had failed to respond to drug management. His behavioral problems were characterized as "intense, continual motoric hyperactivity, distractibility, impulsivity, and inability to fall asleep" (p. 641). His developmental history disclosed a normal pregnancy and birth, an irritable infancy ("screamed constantly"), and a precocious motor development. After the K-P diet was implemented, the parents reported a rapid improvement in their son's behavior, but no essential change was noted in his behavior at school for at least the first month. After six weeks, however, the teachers reported a gradual improvement in his distractibility, fewer temper tantrums, and a decrease in motor activity. After ten weeks, "a marked change in symptomology was obvious" (p. 642). His attention span increased and he was now able to sit still for classroom activities.

Palmer, Rapoport, and Quinn (1975) administered a dietary questionnaire to the parents of 79 boys, ranging in age from six

to 12 years of age. Fifty-six of these boys were patients at the Hyperactivity Clinic of the Georgetown University Hospital. Each patient was rated on the Parent Symptom Questionnaire (Conners, 1970), which is a weighted 93-item scale containing separate factors for restless, aggressive, and immature behaviors. The mean score for the patient sample was 13.26. The control group's mean score was 2.54.

The dietary questionnaire asked for information pertaining to (1) the general food habits of the child; (2) an outline of a 24-hour sample of the child's diet; and (3) the weekly consumption of 50 foods from the main food groups, with attention focused on foods high in additives. Parents specified the type of food, e.g., fresh, frozen, canned, or bottled and the frequency of consumption of an average serving of each food in a week.

No significant differences were found in the diet ratings between patients and the controls (Chi square = 4.06, $df = 2$). The patients consumed no more artificial additives than did the control group.

Criticisms of the Clinical Studies

Several criticisms of Feingold's claims have been discussed in the previous chapter and are equally applicable to the above mentioned studies. There have been various other criticisms raised against Feingold's and others' use of case studies to support the efficacy of the K-P diet. The various reasons for these criticisms are summarized below:

1. More than diet changed - To ensure compliance, the entire family, not just the children, are placed on the diet and

regimen. Diet, however, is only one of the variables that are changed. Parents are instructed to include the child in the various stages of food preparation, thereby providing a closer relationship with the child. Furthermore, it seems quite plausible to assume that these altered family dynamics may be related to the reported improvement in the child (Nutrition Foundation, 1976).

2. Suggestibility - The advocates of the K-P diet are usually very positive about the value of the program (Nutrition Foundation, 1976). Rosenthal and Jacobson (1968) have indicated that the confident expectations generated in school settings may affect a child's performance. It is likely that similar expectations in a family setting may also affect the behavior of the child or parents' ratings of the child's behavioral improvement.

Empirical Studies of the Efficacy of the K-P Diet

Three empirical studies of the efficacy of Feingold's K-P diet have been reported in the literature. These studies are notable for their varying degrees of experimental control, as well as their near unanimous positive findings with regard to the K-P diet's efficacy.

Cook and Woodhill (1976) have reported perhaps the least controlled of the empirical studies. Between March, 1974, and November, 1975, 15 children (one girl aged 4½ years; one infant boy aged 10 months; and 13 boys aged 5.75 years to 13.0 years) were treated with the K-P diet. The socioeconomic status of these Australian families was above average, with 11 families reporting that at least one parent was "professionally qualified." After

the children were diagnosed as being hyperactive by a child psychiatrist, the parents volunteered to participate in the dietary management program. Both parents and child were usually seen twice by the dietitian and "many" of the parents attended two group meetings, at which they shared their experiences in implementing the diet.

The parents were surveyed by a mailed questionnaire in November, 1975, nine months after the treatment began. This questionnaire was not reported, except for the following two questions: (1) how sure are you that the diet at any stage has made a significant improvement in your child's behavior, whether alone or in conjunction with medicines; and (2) how sure are you that your child's behavior can be made worse by breaking the diet. The parents were to make one of the following responses: quite certain, fairly certain, or no change.

Cook and Woodhill (1976) reported that ten families indicated that they were "quite certain" and three other families reported that they were "fairly certain," that (a) the diet substantially reduced their child's hyperactive behavior, and (b) that violations of the diet could cause their child to revert to the previous levels of hyperactive behavior.

There are many severe methodological problems with this study, of which even the authors seem aware, as indicated by several of their statements, e.g., "the ratings of improvement . . . are global rather than specific" (p. 87) and "objective rating scales were not used" (p. 87). The methodological errors inherent in this study include the failure to control for the

placebo effect, the use of a non-validated parent questionnaire as a rating instrument, the lack of any controls, and the lack of objective evidence of behavioral change. This study, then, should be viewed as suggestive, rather than definitive.

Salzman (1976) has reported a study which attempted to obtain higher standards of experimental rigor than did the Cook and Woodhill report. Salzman's study was designed to assess statistically the changes in behavior that occur when hyperactive children, judged to be sensitive to artificial additives, are placed on the K-P diet.

Thirty-one children were given the Hawley-Buckley allergy test (1974) that determines salicylate sensitivity. Of these original 31 children, 18 had positive reactions, and 15 of those 18 subsequently went on the K-P diet.

The mothers of the children rated their child's behavior on a behavior rating scale that was devised by the author. The rating instrument was composed of 49 behavioral categories, reflecting four major areas: impulsiveness, excitability, overactivity, and distractibility. A fifth area, sleep disturbance was also assessed.

Parents were informed of the possible effects of the diet, including the effects of violations of the diet. The posttest measure was an administration of the same parent rating scale, after a four week treatment period.

The reported results indicated that changes in behavior in the five areas were statistically significant at the following levels:

Impulsiveness	$\underline{t}=3.21$	df=14	$p < .005$
Excitability	$\underline{t}=5.20$	df=14	$p < .0005$
Overactivity	$\underline{t}=4.20$	df=14	$p < .005$
Distractibility	$\underline{t}=3.10$	df=14	$p < .005$
Sleep disturbance	$\underline{t}=2.596$	df=14	$p < .025$

Salzman concluded that 93% of the children responded with improved behavior when they were placed on a diet free of artificial flavors and colors, and salicylates. He contends that the use of the K-P diet "significantly affects children with behavior problems and learning difficulties" (p. 250).

There are, however, significant methodological problems contained in Salzman's study. Several of these problems are associated with Salzman's use of his parent questionnaire as a rating instrument. First, Salzman failed to provide any evidence concerning the validity of the questionnaire as a measure of hyperactivity. Second, no checks were made to determine the reliability of the data produced by this questionnaire, making it impossible to determine (a) whether parents initially rated their child accurately; or (b) whether it was the hyperactive behavior of the children, or only the rating behavior of the parents, which changed. Third, parents were informed of the explicit details of the diet, including the time period that the diet should begin to demonstrate its effect, what the effects would be, and what would happen if their child violated the diet. Given these conditions, it would not be surprising if the parent's behavior toward their child changed. Fourth, Salzman presents no evidence that the "categories" which comprise the "areas" of hyperactivity in his scale are either additive or uncorrelated.

Another major methodological error seems to be Salzman's choice of statistical procedures. The t test is a parametric test which assumes normality of distribution of the population, homogeneity of variance of the samples, and continuity of the dependent variable, i.e., interval data (Roscoe, 1975). Violation of the third assumption is particularly serious. The Salzman data are categorical and therefore, his choice of the t test statistic is inappropriate. A non-parametric, inferential statistical test would be more appropriate. This problem, of course, calls into question the statement that "behavioral changes in these five areas were statistically significant" (p. 249).

The third reported empirical study was conducted at the University of Pittsburgh by Connors, Goyette, Southwick, Lees, and Andrulonis (1976). Connors et al. employed a double blind, crossover design with 15 hyperactive children, ranging in age between 6 years and 12 years 11 months. Two symptom rating scales, a 39 item teacher scale and a 93 item parent scale, were employed. Results were reported on data obtained from a 10 item "hyperkinesis index" which represents a distillation of the above scales and purports to measure "the cardinal symptoms of the hyperkinetic syndrome" (p. 155).

An experimental diet, i.e., the K-P diet, and a control diet were employed, with the control diet meeting the following criteria: (a) it should involve the same degree of preparation, shopping, and monitoring as did the K-P diet; (b) it should include items from the same food groups; (c) it should exclude no items

that are excluded in the K-P diet; (d) it should be equally palatable; and (e) it should appear plausible as a treatment approach.

Dietary information was obtained from each child by (a) the use of a dietary questionnaire pertaining to food habits; (b) 24 hour recall, in which all food consumed for the previous 24 hour period was recorded; and (c) a food frequency measure, whereby parents were given a list of foods and were asked to compute the frequency that these foods were consumed by their children during a "typical" week.

The results reported by Connors et al. indicated that the K-P diet is significantly more effective, using a Wilcoxon signed ranks test ($P < .01$), than the control diet as rated by teachers ($P < .005$), but not as rated by the parents. As rated by both teachers and parents, the K-P diet is significantly better than the baseline period ($P < .05$), which was a two week period during which data was taken before either diet was implemented. The control diet was not significantly different from the baseline period.

When the same data are examined by order of treatment, most of the improvement on the K-P diet was noted when it followed the control diet. The authors, however, reported that the order by treatment interaction was nonsignificant. Connors et al. concluded that the data "strongly suggest" that the K-P diet reduced the perceived hyperactivity of some children.

Many of the problems of the previous studies were corrected by Connors and his associates. As noted in a previous chapter, however, there are serious methodological problems in this study and, consequently, many questions regarding the efficacy of Feingold's K-P diet are still unanswered.

After a review of the literature that is relevant to the question of the efficacy of the K-P diet, several conclusions logically follow. First, while there is an adequate supply of clinical studies, reported in an anecdotal manner, there is a paucity of studies that employed even minimal standards of experimental control and rigor. Second, the studies that were empirically based left as many questions unanswered as they purported to answer, as evidenced by the large number of criticisms that can be legitimately raised about any given study. Third, a study needs to be undertaken that will both systematically control confounding variables and investigate the presence of a functional relationship between two critical variables; artificial food additives and specific, objectively measured hyperactive behaviors.

This study explored the relationship between artificial food colors and hyperactivity and, at the same time, attempted to control the sources of error that seemed to characterize the previous studies by obtaining data on specific, well defined behaviors in the presence of the double-blind manipulation of only one variable, i.e., the ingestion of artificial food colors.

CHAPTER III

METHOD AND PROCEDURES

Chapter III will present the methods and procedures of the study. The chapter presents the following three major sections: a description of the subjects; a description of the experimental materials; and a description of the procedures, including the experimental design, the dependent variables, and the data collection.

Subjects

The subjects for this study were two elementary school students, both eight year old females. The children had been on the Feingold K-P diet for at least 11 months preceding the beginning date of this study. (See Appendix B for a further description of the subjects.)

There were five selection criteria that the subjects had to satisfy before they were considered eligible to participate in this study. Briefly, these criteria were

1. Each child had previously been diagnosed by a physician as being hyperactive, with a subsequent prescription of a psychostimulant medication as a treatment regimen.
2. If psychostimulant medication was implemented in a program of pharmacological behavior modification, it must have been discon-

tinued for a minimum period of four months immediately prior to participation in the study.

3. Each child's behavioral manifestations of the hyperactive syndrome must have been present for a minimum of two years.

4. Each child must currently rely on the Feingold K-P diet as the apparently exclusive means of behavioral control.

5. The child must have been on the K-P diet for a minimum period of four months immediately prior to participation in this study.

Materials

The experimental material used in this study was a food item provided by the researcher for the subjects for daily consumption. This food item, an oatmeal-type cookie (Feingold, 1975b, p. 187) (See Appendix C), was present across all experimental conditions, except an initial baseline period. On two occasions, for each subject, the cookie contained artificial additives, i.e., artificial food color. The experimental solution was obtained by the following procedure (Hawley & Buckley, 1974): 2 cc basic food color diluted with 8 cc of distilled water; 2 cc of this solution is diluted with 8 cc of distilled water; and then, 2 cc of this solution is diluted with 8 cc of distilled water. This last solution was the test solution and, when included in the recipe for the experimental food item, constituted the treatment condition. At all other times, the recipe for the food item specifically excluded all artificial and naturally occurring salicylates.

A drug checklist was also completed by parents, which included prescription and over-the-counter medications. This drug checklist was not considered data that requires analysis, but is included as a conservative measure of control (Appendix D).

A daily log was provided for the parents to record their informal observations of their child's behavior. The log was open-ended so that the parents were instructed to record only significant behavioral information, e.g., increased hyperactivity or disruption of sleep habits, rather than writing daily observations. Also included in the parents' log was a daily check-off that indicated whether the experimental food item was eaten on any given day (See Appendix E).

Procedures

Experimental Design

The experimental design for this study is a variation of the BAB design (Huck, Cormier, & Bounds, 1974) and was a $B_1AB_1B_2AB_2$ with two replications for subject L ($B_1AB_1B_2AB_2AB_2$) and three replications for Subject K ($B_1AB_1AB_1B_2AB_2AB_2$). These treatment conditions are summarized below:

B_1 = K-P diet, no experimenter provided food item

B_2 = K-P diet, introduction of experimenter provided
neutral food item

A = K-P diet, experimenter provided food item with
artificial additives

The B_1 condition was included, so that data could be collected prior to the introduction of the experimenter provided food item.

The data collected in this condition served as a measure of control of any placebo effect that may have occurred as a result of the introduction of the food item.

The data was collected according to the following schedule:

Number of Experimental Sessions (Days) Per Child

<u>Phase</u>	<u>Child L</u>	<u>Phase</u>	<u>Child K</u>
B ₁	1 - 8	B ₁	1 - 10
A	9 - 10	A	11 - 12
B ₁	11 - 15	B ₁	13 - 14
B ₂	16 - 22	A	15 - 16
A	23 - 24	B ₁	17 - 18
B ₂	25 - 30	B ₂	19 - 24
A	31 - 32	A	25 - 26
B ₂	33 - 42	B ₂	27 - 29
		A	30 - 31
		B ₂	32 - 38

This design was selected for use in this study for three major reasons: (a) reversal strategies can be used with an individual subject (Baer, Wolf, & Risley, 1968; Huck et al., 1974; Risley & Baer, 1973; Sidman, 1960); (b) it allows the researcher to demonstrate experimental control if the behavior changes only at the point when the treatment is introduced (Huck et al., 1974; Risley & Baer, 1973; Sidman, 1960); and (c) it facilitates direct measurement over time of specified observable behaviors (Risley & Baer, 1973; Sidman, 1960).

Double Blind. The introduction of the artificial additives was introduced under double-blind conditions in which the observers and the child and his parents were unaware of the timing of the induction. The double-blind condition was obtained by providing the food items in consecutively numbered containers, with only the experimenter being aware of the specific food item that contained the artificial colors.

The observers were also kept in a "blind" condition with regard to the intent of the study. The observers were told by the experimenter that the purpose of the research was to determine whether hyperactive behaviors were consistent across settings. To this end, the school based data they collected would be compared with data that was to be collected in the home by other observers.

While the parents were not "blind" as to the intent of the study, they were unaware of the design of the study. The experimenter informed the parents that their child would be participating in a group study, of unspecified size, in which some children would receive additives while other children would not. They were not provided information about their child's "group membership."

Placebo. There were two controls, both direct and indirect, on the placebo effect. First, indirect control was attained by assuming that the placebo effects of the K-P diet will be washed out by the length of time that each child has been on the diet prior to the beginning of this study, as mentioned in an earlier section of this chapter. Second, the placebo effects of the experimenter

provided food item were monitored through the collection of data across all conditions, including prior to the introduction of the food item, thereby providing direct information regarding any placebo effects.

Dependent Variables

Three dependent variables were selected for this study. The dependent variables are specific, observable behaviors that are representative of several behavioral categories that are characteristic of the hyperactive behavior syndrome. These three dependent variables are operationally defined below:

1. On task - subject looking at the relevant assigned task stimulus. Conversely, "off task" will be defined as the subject's eyes not looking at the assigned task stimulus, with a five second latency subsequent to the termination of the previous "on task" episode. The unit of measurement of this variable will be duration, i.e., number of minutes, of "on task" and duration of "off task." On task behavior will represent the "Short Attention Span" category as described in Chapter II.

2. Out of Seat - not having posterior on the seat portion of the desk, chair, or bench. The units of measurement for this variable are the frequency of occurrence and duration, i.e., number of minutes, of out of seat behavior. Out of seat behavior will represent the "Overactivity" category, as described in Chapter II.

3. Physical aggression - defined as hits, slaps, swipes, kicks, bites, or scratches direct toward other people. The unit of measure-

ment for this variable will also be the frequency of occurrence. Physical aggression will represent the behavioral categories of "Low Frustration Tolerance" and "Aggressiveness," as described in Chapter II.

Data Collection

The data was collected during daily observations of the children in their normal school environment, i.e., the classroom, over a period of 30 school days. These observations occurred at approximately the same time each day and lasted for a period of 30 minutes.

The data was recorded during the observation period, by using a modification of the General Survey Recording method (Koorland & Rose, Note 1), in which the behavior recording form consisted of 15 pages, each representing a two-minute interval. The observer turned the page at the end of each two minute interval, so that each page only reflected data collected during a given two-minute period. These time blocks were measured by a stopwatch, which was fixed to the observer's clipboard. This watch was started by the observer at the beginning of each observation period and allowed to run uninterrupted for the full 30 minutes. The observer was required to make tally marks and/or record duration measures on the recording form in the correct time block. A further requirement was that the observer manually operate a second, hand-held, stopwatch, so as to record accurately the essential duration measures of the on task and out of seat behaviors. This modification of the General Survey Recording method permitted the observer

to spend a maximum amount of time observing, with minimal effort required to record the occurrences of the dependent variables (Appendix F).

The data recorded during observation periods were transferred to Standard Behavior Charts (Pennypacker, Koenig, & Lindsley, 1972) for analysis.

Observers. The data collectors were graduate students in the Department of Special Education of the College of Education, University of Florida. The data collectors were trained to be behavioral observers by the researcher, during a pre-experimental training period. The specific skills the observers acquired during the pre-experimental training sessions included (1) a thorough understanding of the operational definitions of the dependent variables; (2) accurate observations of the dependent variables; (3) facility with the recording form; (4) facility in the use of the stopwatch; and (5) classroom etiquette (Koorland & Rose, Note 1), including classroom entry behaviors, observer behavior during observation period, and classroom exit behaviors.

The pre-experimental training period included the following instructional procedures: explanation and discussion of dependent variables and observer responsibilities; role playing; and viewing pre-recorded video tapes that were pre-observed in order to ascertain absolute standard data for each dependent measure.

Two observers were used during this study, one for each child. Observer reliability was determined by comparing the observer's data against the pre-recorded absolute standard data

on several videotapes of children in classroom settings. These data were compared using the "exact agreement method" (Repp, Deitz, Boles, Deitz, & Repp, 1976), in which the two-minute intervals were scored as intervals of agreement if the observer and the standard data sheets showed the recording of the same number of responses. The exact agreement method produces a conservative agreement percentage, especially when large time intervals are used (Repp et al., 1976). Observer reliability was determined by forming a ratio between the standard data and the observer data, regarding each dependent variable (Johnson & Bolsted, 1973). The minimum requirement for satisfactory observer reliability was 80 percent for each behavior.

CHAPTER IV

RESULTS

The basic data used in this study were frequency and duration. Frequency, the number of occurrences of a given behavior emitted by an individual per minute (Pennypacker, Koenig, & Lindsley, 1972), was the datum for the behaviors of "out of seat" and "physical aggression." Duration, the amount of time that the individual emits a given behavior (Pennypacker et al., 1972), was the datum for "on task" behavior as well as "out of seat" behavior.

The method used to determine observer reliability was described in a previous chapter. The results of the observer reliability checks, using the exact agreement method (Repp, Deitz, Boles, Deitz, & Repp, 1976) are

<u>Behavior</u>	<u>Observer A</u>			<u>Observer B</u>		
	<u>Time Intervals</u>			<u>Time Intervals</u>		
	<u>Total</u>	<u>Agreement</u>	<u>Percentage</u>	<u>Total</u>	<u>Agreement</u>	<u>Percentage</u>
On Task	17	14	82.35%	17	14	82.35%
Out of Seat	17	16	94.11%	17	15	88.23%
Physical Aggression	17	17	100.00%	17	17	100.00%

Three basic measures were used for analysis of the frequencies and durations obtained in this study. These three measures were chosen for

use in this study because they accurately describe the status and change in frequency and duration measures. Midpoints, the median of all individual measures within a phase, describe either the number of occurrences or amount of time that each behavior occurred during that phase (Pennypacker et al., 1972). The range of variability of a given behavior within a phase are used to describe the amount of the range that is shared across phases. Ratio multipliers, either frequency multipliers or duration multipliers when duration is expressed as a ratio, are used to describe the amount of change in the dependent measure across phases.

Comparisons were made between the various midpoints. These comparisons were made by forming ratios which yielded midpoint multipliers. Multipliers are obtained by dividing the smaller midpoint into the larger, which allows the expression of a comparison measure as a single multiplier (Pennypacker et al., 1972). The direction of change is expressed by the mathematical symbols for the operations of multiplication and division, so that a multiplier that demonstrates an increase is preceded by a "x" sign, while one that demonstrates a decrease is preceded by a "/" sign (Pennypacker et al., 1972). These multipliers clearly demonstrate the relationship between the differing rates of behavior in the presence or absence of artificial food colors.

Midpoint Analysis

Midpoints were obtained for all experimental phases, including the baseline (B1), the neutral food phase (B2), and the challenge or

active food phase (A), and are presented in Table 1. In addition, Table 1 presents a further subdivision of the challenge (A) phase. The 1A column represents the midpoints for only the first day's data in the challenge phases, while the A column represents the midpoints for both the first and second days of the challenge phases.

Table 1
Midpoints Within Phases

<u>Behavior</u>	<u>Phases</u>			
	B1	B2	A	1A
<u>Subject: K</u>				
On Task (Ratio-Duration)	.890	.877	.754	.540
Out of Seat (Ratio-Duration)	.017	.031	.159	.177
Out of Seat (Frequencies)	.100	.100	.217	.200
Physical Aggression* (Frequencies)	0	0	0	0
<u>Subject: L</u>				
On Task (Ratio-Duration)	.646	.609	.352	.432
Out of Seat (Ratio-Duration)	.162	.222	.476	.492
Out of Seat (Frequencies)	.267	.300	.606	.733
Physical Aggression* (Frequencies)	0	0	0	0

*Physical aggression occurred so infrequently that the midpoints are zero, even though this behavior did occur occasionally.

The duration data in Table 1 may be read as percentages of time that the subject spent emitting a given behavior. For example, subject K's midpoint on-task was 89% of the observation period during the B1 phase.

There are five comparisons of midpoints that require analysis. The initial baseline phase (B1) must be compared with the phase in which the neutral food substance was introduced (B2) to determine the presence of any placebo effect. Two, the B1 phase must be compared to the phases in which the artificial food colors were introduced (A), because a challenge phase occurred before the introduction of the B2 phase. The B1 phase must also be compared to the first treatment days data (1A) to determine the initial effects of the introduction of the artificial food colors. Four, the B2 phase must be compared to the A phase, to determine the effects of the ingestion of the artificial food colors. For the same reason, the B2 phase was compared to the 1A phase.

A comparison of the midpoints of A and 1A was not done because the 1A phase is a subdivision of the A phase. An informal comparison of the 1A and A midpoints and the raw data on the Standard Behavior Charts (Appendix H), however, indicates an interesting phenomenon. The treatment effects for two behaviors, i.e., frequency of out of seat for Subject K and the duration of on-task for Subject L, were usually more pronounced on the second treatment day, whereas for all other treatment phases the treatment effects on the first treatment day were the strongest. The length of the treatment effects, i.e., two days, was not altered in these cases, however. Unfortunately, the data do not allow an interpretation of this phenomenon.

The midpoints for the B1 and B2 phases are similar and seem to eliminate the possibility of a placebo effect. The individual midpoints uniformly shifted toward measures indicative of increased inappropriate behavior when the latter four midpoint comparisons were made, i.e., B1 to A, B1 to 1A, B2 to A, and B2 to 1A.

In every phase, across both subjects, the Physical Aggression measure was not conclusive and did not seem to be a behavior that was sensitive to this particular treatment variable. The other three dependent variables, however, demonstrated sensitivity to the treatment variable, as evidenced by the shifts in the midpoints. The differences in midpoints for the two active treatment measures, A and 1A, are fairly stable, with the exceptions of On Task for subject K and Out of Seat frequencies for subject L. These two midpoint comparisons indicate a major shift toward more inappropriate behavior during the 1A phase than during the A phase.

Midpoint multipliers were computed in order to illustrate the magnitude of the differences between the phases. The individual midpoint multipliers are presented in Table 2.

The midpoint multipliers clearly show that the greatest change in the midpoints occurs when the active food substance was introduced, regardless of the phase that preceded that introduction. The midpoints for each dependent measure were averaged across both subjects, thereby yielding mean midpoints for each behavior within a treatment phase. The mean midpoints were then computed as a ratio, stated as the mean midpoint multiplier. The mean midpoints are presented in Table 3 and the mean midpoint multipliers are presented in Table 4.

Table 2
Midpoint Multipliers

<u>Behavior</u>	<u>Phases</u>				
	B1:B2	B1:A	B1:1A	B2:A	B2:1A
<u>Subject: K</u>					
On Task (Duration)	+1.02	+1.18	+1.65	+1.16	+1.62
Out of Seat (Duration)	x1.77	x9.23	x10.27	x5.20	x5.79
Out of Seat (Frequency)	x1.00	x2.17	x2.00	x2.17	x2.00
Physical Aggression (Frequency)	x1.00	x1.00	x1.00	x1.00	x1.00
<u>Subject: L</u>					
On Task (Duration)	+1.06	+1.84	+1.50	+1.73	+1.41
Out of Seat (Duration)	x1.37	x2.94	x3.04	x2.15	x2.22
Out of Seat (Frequencies)	x1.13	x2.27	x2.75	x2.02	x2.44
Physical Aggression (Frequency)	x1.00	x1.00	x1.00	x1.00	x1.00

Table 3
Mean Midpoints

<u>Behavior</u>	<u>Phases</u>			
	B1	B2	A	1A
On Task (Duration Ratio)	.768	.743	.553	.486
Out of Seat (Duration Ratio)	.090	.126	.317	.335
Out of Seat (Frequency)	.183	.200	.411	.466
Physical Aggression (Frequency)	0	0	0	0

Table 4
Mean Midpoint Multipliers

<u>Behavior</u>	<u>Phases</u>				
	B1:Ba	B1:A	B1:1A	B2:A	B2:1A
On Task (Duration)	+1.03	+1.39	+1.58	+1.34	+1.53
Out of Seat (Duration)	x1.40	x3.52	x3.72	x2.52	x2.66
Out of Seat (Frequency)	x1.09	x2.25	x2.55	x2.06	x2.33
Physical Aggression (Frequency)	x1.00	x1.00	x1.00	x1.00	x1.00

Tables 3 and 4 indicate that the differences between the two non-treatment phases, B1 and B2, were minimal, especially when compared to the magnitude of the changes between non-treatment and active phases. While the increase in duration of Out of Seat between B1 and B2 seems large, it is actually a relatively small change when compared with the measures of change between the non-treatment and active phases, as shown in Table 5.

Table 5
Change in Mean Midpoints

<u>Behavior</u>	<u>Phases</u>				
	B1:B2	B1:A	B1:1A	B2:A	B2:1A
On Task (Duration)	- 3.3%	-28.0%	-36.7%	-25.6%	-34.6%
Out of Seat (Duration)	+40.0%	+252.2%	+272.2%	+151.6%	+165.9%
Out of Seat (Frequency)	+ 9.3%	+124.6%	+154.6%	+105.5%	+133.0%
Physical Aggression (Frequency)	0	0	0	0	0

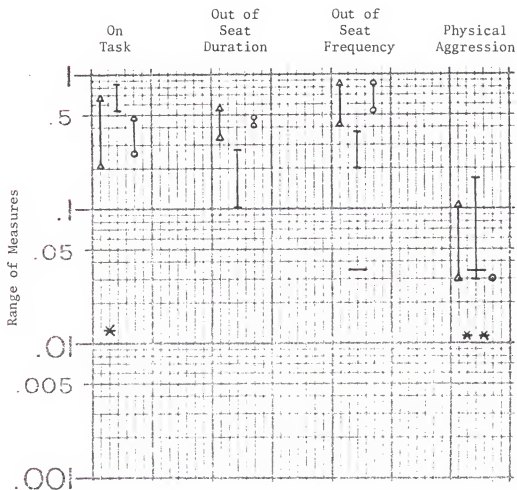
These measures of change in mean midpoints provide another indication of the magnitude of change in the presence of the active food substance, as well as an indication of the consistency in that change.

Range of Variability

The changes in the dependent measures appear to be so dramatic that the investigator sought to determine a format that would demonstrate a dichotomous shift in the duration and frequencies of the dependent measures. A graphic display of the amount of overlap in the measures across treatment phases was chosen as the format for the dissemination of this information. Figures 1 through 4 present graphically the ranges and overlap for each behavior within subjects.

Figure 1 indicates that, for subject L, there was overlap in the ranges for two of the measures when comparing B1 to A to 1A. These overlaps occurred in duration of On Task and Physical Aggression. Physical Aggression, however, was felt to be an insensitive measure and, therefore, that information is not very enlightening. Of more interest is the fact that there were no instances of overlap when comparing the ranges of B1 to 1A, which indicate more powerful treatment effects on the first treatment days.

Figure 2 reveals three overlaps in the ranges of B2, A, and 1A. Again, physical aggression demonstrates an overlap, but only because the frequencies for the A and 1A phases were zero. In the second overlap, frequency of Out of Seat, the overlap is minimal because the highest non-treatment frequency (.433) equaled the lowest frequency of the A phase. The third overlap, Duration of On Task, is apparent between B2 and A, but not, however, between Ba and 1A. There were no overlaps, other than physical aggression, between B2 and 1A.



Key

- ⌋ = Pretreatment Range
- ⬆ = A Phase Range
- ⬇ = 1A Phase Range
- * = Overlap
- = Record Floor

Figure 1

Ranges of Variability

Phases: B1 to A, 1A

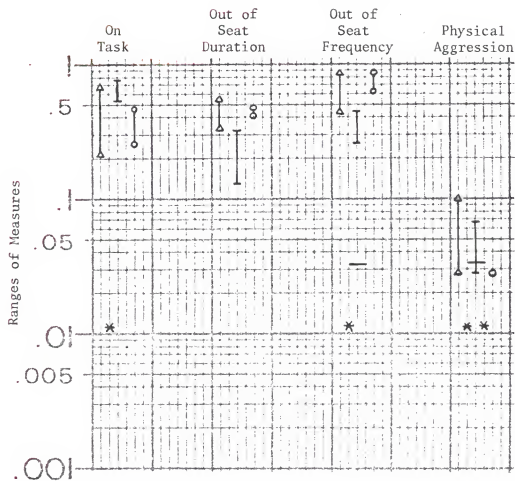


Figure 2
 Ranges of Variability
 Phases: B2 to A, 1A

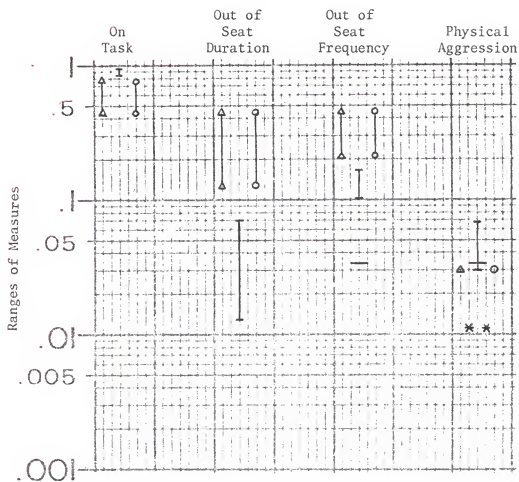


Figure 3

Ranges of Variability

Phases: B1 to A, 1A

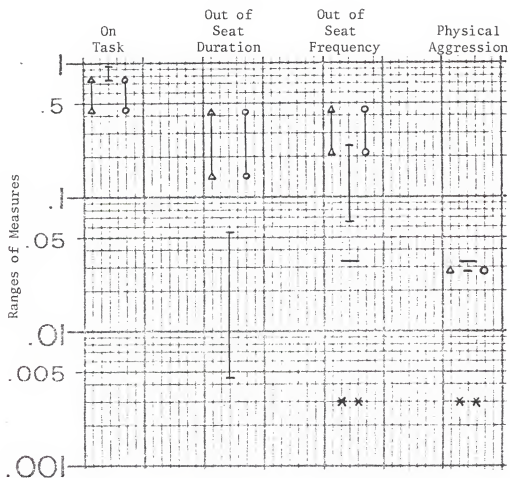


Figure 4
 Ranges of Variability
 Phases: B2 to A, 1A

In Figure 3 no overlap occurs between B1 and either A or 1A in the first three measures. Physical aggression again shows overlap, essentially because the lowest frequencies for all phases were zero.

Figure 4 displays the only dependent measure with consistent overlap between non-treatment and active phases. The frequencies for Out of Seat demonstrate overlap between B2 and A as well as B2 and 1A, with .233 being the highest frequency for the B2 phase and .200 the lowest frequency for both A and 1A. (It is perhaps interesting to note that the .233-B2 frequency only occurred once and the next highest B2 frequency was .133, which would not have produced an overlap with either A or 1A).

The graphic displays of the variability ranges indicate that there was a pronounced dichotomy in the ranges of the dependent measures between non-treatment and treatment phases. These dichotomous ranges, by demonstrating that the behaviors shifted to different levels of duration and frequency and thereby indicated minimal overlap, argue for the existence of a functional relationship between the ingestion of artificial food colors and hyperactivity for the subjects of this study. (See Appendix G for a tabular presentation of the variability ranges.)

Ratio Multipliers

Ratio multipliers were computed on the duration and frequency measures across phases. The duration ratio was determined by dividing time spent emitting a given behavior by the total time

available to emit that behavior, i.e., the observation period. The ratio multipliers were computed by obtaining the ratio for a given behavior on the day preceding a treatment induction and the ratio for that behavior on the first day of the treatment induction. Ratio multipliers were then obtained by dividing the smaller ratio into the larger and then using the appropriate symbolic prefix to designate direction of change across the phase. The ratio multipliers of the dependent measures for each experimental induction are presented in Table 6.

The last group of measures for each subject in Table 6 provides an average ratio multiplier for a given dependent measure for that subject. For both subjects the induction of the artificial food color prompted consistent changes in the ratios. For subject L the duration of Out of Seat and the frequencies of Out of Seat were more than twice as high during the LA phase than during the preceding pre-treatment days. Subject L's duration of On Task was an average of 40.8% lower during 1A than during the pre-treatment days. For subject K, the duration of Out of Seat was an average of over 25 times higher during 1A than in the pre-treatment days and the frequency of Out of Seat was over $2\frac{1}{2}$ times as high during 1A. The duration of On Task was an average of 23.9% lower during 1A than during the immediately preceding non-treatment days. As in other analyses, physical aggression provided an inconclusive measure.

Graphic displays of the original data, as plotted on Standard Behavior Charts, are available in Appendix H. These charts display the data as they appeared before the above mathematical summaries

Table 6
Multipliers

K	OT-D	OS-D	OS-F	PA-F
Pre	.890	.017	.133	0
Post	.760	.177	.200	0
Mult	+1.17	x10.27	x1.50	x1.0
Pre	.939	.007	.100	0
Post	.540	.409	.433	0
Mult	+1.14	x61.09	x4.33	x1.0
Pre	.929	.004	.067	0
Post	.799	.141	.233	0
Mult	+1.16	x32.72	x3.48	x1.0
Avg				
Pre	.919	.009	0.1	0
Post	.699	.242	0.289	0
Mult	+1.31	x25.77	x2.89	x1.0
L	OT-D	OS-D	OS-F	PA-F
Pre	.836	.126	.233	0
Post	.470	.493	.733	0
Mult	+1.78	x3.91	x3.15	x1.0
Pre	.547	.237	.367	0
Post	.432	.492	.867	0
Mult	+1.27	x2.08	x2.36	x1.0
Pre	.583	.273	.433	0
Post	.261	.405	.611	0
Mult	+2.23	x1.48	x1.41	x1.0
Avg				
Pre	.655	.212	.344	0
Post	.388	.463	.737	0
Mult	+1.69	x2.19	x2.14	x1.0

Key: OT-D = On Task Duration OS-D = Out of Seat Duration
 OS-F = Out of Seat Frequency PA-F = Physical Aggression
 Frequency

were performed. A visual inspection of these data provides an equally strong argument for the existence of a functional relationship between the ingestion of artificial food colors and hyperactive behavior in the subjects of this study. The raw data for each subject are presented in Appendix I.

CHAPTER V

DISCUSSION

There has been a great deal of public interest in the Feingold K-P diet as a treatment for hyperactivity. At the same time, concerns have been voiced about the public's acceptance of the K-P diet without any supportive empirical evidence regarding its efficacy. If the Feingold diet were proven to be an effective treatment approach, there would be important educational, as well as public health, implications. For these reasons this study was designed to determine the existence of a functional relationship between the ingestion of artificial food colors and changes in the frequency and/or duration of occurrence of specified behaviors, i.e., on task, out of seat, and physical aggression, which are characteristic of the behavioral syndrome of hyperactivity.

Discussion and Implications

In the following section the reader will find discussions of three major areas. The first area contains a presentation of a summary discussion of the findings of the study and an interpretation of those findings. The second major area is a discussion of the problems and limitations that were encountered during

the course of the study. The third area includes a discussion of the implications of the study for the practitioner.

Findings

The findings of this study, while not at variance with other empirical studies of the effects of the K-P diet, are, nevertheless, different from those findings. These differences accrue primarily from the design of the study and the types of experimental questions that were asked. While other studies have focused on comparisons of behavioral effects in the presence of two different diets, this study has focused on the manipulation of a single, critical variable, i.e., artificial food colors, and the investigation of the degree of control that variable had on the frequency and/or duration of selected hyperactive behaviors.

The analysis of the data that were collected relative to the three experimental questions of the study indicated four major findings. These questions are listed below with a subsequent presentation of the data relevant to that question and the conclusions those data allow to be drawn.

1. Is there a functional relationship between the ingestion of artificial food colors and the increased frequency of characteristic hyperactive behaviors?

The mean midpoint between phases, because it is a summary measure, provides indication of the effects of artificial food colors on hyperactive behaviors. The mean midpoint of Out of Seat behavior for the A phase (artificial food colors present in diet) was 124.6% higher than for the B1 phase (observer present

in classroom) and was 105.5% higher than the mean midpoint of the B2 phase (neutral food substance provided by the investigator). The mean midpoint of the first treatment days (1A) provide a more dramatic treatment effect. The mean midpoint for the 1A phase was 154.6% higher than the B1 phase and 133.0% higher than the B2 phase. The mean midpoint for Physical Aggression was zero in every phase, so, on this measure, there appeared to be no treatment effects.

The average ratio multipliers are also a representative summary measure. For both subjects the frequencies of Out of Seat were over twice as high during the 1A phase than during the immediately preceding non-treatment days. As in other measures, the frequencies of Physical Aggression displayed no change across treatment conditions.

Given the above data, the conclusion may be drawn that there is, indeed, a functional relationship between the ingestion of artificial food colors and an increase in the frequencies of hyperactive behavior in the subjects of this study. The changes in the frequencies of Out of Seat behavior appear conclusive. The frequencies of Physically Aggressive behaviors are far less conclusive, but this inconclusiveness is more likely a comment on the sensitivity of the behavior rather than on the effects of the independent variable.

In addition to the strong support of the above summary data, the individual data support the contention of a function relationship. Through visual inspection of the daily data, as graphically displayed on the Standard Behavior Chart, it can

be seen that the changes in frequency of Out of Seat behavior were consistent and dramatic, thereby indicating powerful treatment effects.

2. Is there a functional relationship between the ingestion of artificial food colors and the increased duration of characteristic hyperactive behavior?

Two behaviors, On Task and Out of Seat, provided duration data. The mean midpoint for On Task demonstrated a decrease in the A phase of 28.0% from the On Task duration in the B1 phase and a 25.6% reduction in duration in the A phase when compared to the B2 phase. When a comparison was made between the non-treatment phases and the 1A phase, there was a decrease of 36.7% from the B1 phase to the 1A phase and the duration of On Task in the 1A phase was 34.6% lower than during the B2 phase.

The changes in duration of Out of Seat behavior between non-treatment and treatment phases were the most convincing data. The mean midpoint for duration of Out of Seat in the A phase was 252.2% higher than during the B1 phase and 151.6% higher during the B2 phase. During the 1A phase, the duration of Out of Seat was 272.2% higher than B1 and 165.9% higher than B2.

The ratio multipliers provide further evidence of a functional relationship. For Subject L, the duration of Out of Seat was more than twice as high, on the average, during the 1A phases than during the immediately preceding non-treatment days. The duration of On Task was an average of 40.8% lower during 1A than during the

pre-treatment days. For Subject K, the duration of On Task was an average of 23.9% lower during 1A than during the immediately preceding non-treatment days and the duration of Out of Seat was over 25 times higher during the treatment phase. The original data, as plotted on the Standard Behavior Chart, demonstrates a consistent shift in the data at each treatment induction for both subjects.

In light of the above data, one could conclude that, for the subjects studied, there is, indeed, a functional relationship between the ingestion of artificial food colors and a change in the duration of hyperactive behaviors.

3. How long is the time span during which behavior is affected by the ingestion of a single dose of an artificial food color?

As can be seen in the graphic displays of the data on the Standard Behavior Chart, the time span is consistently two days. On almost every induction, the first days' data (phase 1A) indicates more hyperactive behavior than on the second day.

The fourth major finding that becomes apparent after an analysis of the data is that there is a differential sensitivity of the dependent measures (behaviors) that were chosen for use in the study. Physically aggressive behaviors were not sensitive enough to the treatment variable to allow the detection of any treatment effects. The changes that occurred in the frequency of Physical Aggression were essentially random in relation to the treatment variable. From this data, it may be assumed that Physical Aggression was under the control of variables other than the presence of artificial food colors.

These findings were supplemented by other pieces of information that accrued from an analysis of the data. First, the data demonstrated powerful and consistent changes in the dependent measures within four hours after the ingestion of the food additives. Second, as can be seen by comparing the parents' comments on the Parent Log (Appendix E) and the data as plotted on the Standard Behavior Charts (Appendix H), the parents' reported changes on their child's behavior coincided with changes in the data.

Interpretation of the Findings

These data allow several important interpretations of the findings to be made. First, and foremost, the presence of a functional relationship between the ingestion of artificial food colors and an increase in the frequency and/or duration of selected hyperactive behaviors was established for the subjects of this study. The magnitude of the changes in the dependent measures upon introduction of a small dose of food colors argues convincingly for the acceptance of this conclusion. In addition to the magnitude of change, the consistency of change provides additional evidence with which to support the existence of a functional relationship. In essence, this study provides seven replications of the experimental condition, i.e., the ingestion of artificial food colors and, in each case, the changes in the dependent measures were large and predictable.

Feingold (1975a, 1976) has mentioned that the length of time that a child's behavior may be disrupted by ingesting artificial additives may be as long as four days. The data

obtained in this study indicated that the time span was two days. These data form the basis of the second major conclusion. It took the child's body a certain amount of time, i.e., two days, to purge itself of the chemical additives and thereby return to a behavioral state that is free of the disruptive effects of those chemical agents. In most instances, this internal purging was a rather gradual process, so that the behavioral effects of the artificial colors were less pronounced on the second day than on the first treatment day.

The third conclusion that can be drawn from these data refers to the core of any research that may be attempted in this area. Because there was a differential sensitivity in the dependent measures, so that Physical Aggression did not display any experimental effects, then one may assume that there are certain classes of behaviors that are affected by the ingestion of artificial colors while other classes of behavior may not be affected.

Problems and Limitations of the Study

There were at least two problems that appeared during the course of the study. While it is not felt that either of the problems present a serious threat to the findings of the study or to the reliability of the data, the reader should be aware of these problems.

The first problem was unique to Subject K and was caused by her school's environment. Subject K attended a private school that adhered to an "open" school philosophy. Many times classes

were cancelled so that the children would be free to participate in enrichment activities, such as serving lunch to members of the community. This school policy led to a reduced number of observation periods that were available for data collection which, in turn, led to fewer data points being available for analysis. The severity of this particular problem became apparent when K was unavailable for observation during one of the treatment days. Consequently, the first day's data (1A phase) were lost for that experimental phase. At other times, preplanned interventions occurred before sufficient data were obtained regarding the steady state condition of the non-treatment phase. In spite of this problem and the resultant loss of data, it is felt that the accumulated data is powerful enough for conclusions to be drawn about the treatment effects. In future studies, this problem could probably best be avoided by either selecting subjects that are in a more traditional school environment or by selecting dependent measures that are more amenable to a less structured setting.

The second problem encountered during the course of this study concerned the instances when the children did not adhere to the dietary restrictions of the K-P diet. Fortunately, these dietary infractions were few and the dependent measures were sensitive enough to demonstrate a change in the subject's behavior when the infractions occurred. These changes in behavior would have remained unexplained, however, had the parents not been responsible for keeping a daily log in which they noted the

infractions. This problem can best be overcome in future studies by either having more control over the subject's dietary intake or by requiring that parents furnish supplementary dietary and behavioral information, as was done in this study.

Practical Implications

A number of findings were derived from the data in this study which may have practical implications for others involved in either applied practice or research in this area. The first implications are pertinent to practitioners in a wide variety of fields of study. For the first time, there is empirical evidence that Dr. B. F. Feingold's K-P diet is an effective treatment approach. This also implies that the presence of artificial colors in the diet of a subpopulation of the larger population of hyperactive children does have a causative effect on hyperactive behavior. These findings may lead to increased research in the food additive industry, stricter regulations by the Food and Drug Administration, new laws governing the labeling of food content, increased bio-medical research into the physiological causes of this effect, and more behavioral research concerning behavioral parameters and management strategies for people with this dietary susceptibility.

Second, practitioners, including physicians, must be alerted to the potential of the Feingold K-P diet as a screening device, especially when the alternative treatment strategy may include psychostimulant medication. While the length of time

that a child must be on the diet before its effects are demonstrated has not been established, it would seem that perhaps an extended period of time, even a month or two, as a trial may be worthwhile.

Third, the implications of using objective descriptions of behavior and objective measures of those behaviors are clear. There seem to be certain behaviors and behavioral measures that are not sufficiently sensitive to establish either the presence of a treatment effect or a functional relationship. It would seem that these findings should prompt any practitioner to give serious consideration to the class of behaviors that will be monitored, the measures chosen to accumulate data, and the number of behaviors that will have to be monitored.

Suggestions for Future Research

Research that investigates the interactions of and the relationship between artificial food additives and behavioral manifestations has only recently received attention. As such, there are many and varied areas that deserve future investigative interest. The present study has generated numerous experimental questions that must be answered before one can be certain of the generalizability of the findings and conclusions of this study.

Sidman (1960) has discussed two types of replication. Direct replication, wherein no major experimental variables are changed, is always impossible to obtain in applied settings. Systematic replication, wherein the experimental variables are changed in a systematic manner, holds great promise for future

researchers. Assuming that the research design is held constant, then the following discussion will present some of the variables that should be investigated in future research. First, subjects should be selected with differing age levels, to investigate the possibility of a differential treatment effect at different ages. Second, because both subjects in this study were female, future research should include male subjects, in order to determine whether there are differential treatment effects based on sex differences. A third variable that should be systematically examined is the dosage level of the artificial food color. The effects of larger and smaller doses need to be evaluated, as well as the dosage parameters. The relationship between dosage levels and changes in behavior could lead to other related areas of research. For example, is there a differential effect between artificial additives and the naturally occurring salicylate groups? Do all artificial colors have to be excluded from the diet or is there a differential effect among the different artificial colors, so that some produce more change in behavior and other colors produce little or no change?

Fourth, future research may concentrate on the effects of food colors on different dependent measures (behaviors). This area of research seems especially important because of the findings in this study regarding differential sensitivity of the measures. Fifth, the interaction of artificial food colors and behaviors in other settings may be investigated to determine whether there is a differential treatment effect across settings.

As the above systematic replications are completed, another area of future research will become progressively more relevant. Researchers will need to concern themselves with determining the most appropriate behavior management techniques for use in applied settings when the child has either violated the diet, i.e., ingested an artificial additive, or has not yet begun a dietary treatment regimen. The data from the present study indicate that the effects of ingesting artificial food colors last for two days. The data, when combined with parental reports, also indicate that infractions of the dietary regimen do occur and that the behavioral effects were consistent with those in the treatment phases. In addition, the data displayed stability within treatment phases, so one can conclude that the effects can be expected to occur when additives are ingested. Research that will help to determine the best management strategies will be of utmost importance to the practitioner who must interact with the child during those periods of dietary violation and the behavioral manifestations that are a consequent of those violations.

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APPENDIX A

K-P DIET

These foods are to be eliminated from the diet.

Cereals and Grain Products

All breakfast cereals with artificial colors or flavors

All cakes, cookies, pastries, sweet rolls, donuts, breads,
etc. with artificial flavors or colors (i.e., from
bakery)

Manufactured pie crusts

Frozen baked mixes

Prepared poultry stuffing

Fruits

Almonds

Apples

Apricots

Berries - blackberries, blueberries, boysenberries,
gooseberries, raspberries, strawberries

Cherries

Currants - grapes and raisins or any products made of
grapes (e.g., wine, wine vinegar, jellies)

Nectarines

Oranges

Peaches

Vegetables

Tomatoes and all tomato products

Cucumbers (pickles)

Protein Sources

Meats

Bologna, luncheon meats

Salami

Frankfurters

Sausage

Meat Loaf

Ham, bacon, pork

All barbecued types of chicken

All turkey prepared with basting, called "self-basting"

Frozen fish fillets that are dyed or flavored - fish sticks
or patties, dyed or flavored

Dairy Products

Manufactured ice cream or ice milk unless label specifies
no synthetic coloring or flavoring

Colored cheeses (i.e., processed or yellow or orange)

All instant breakfast drinks and preparations

Flavored yogurt

Prepared chocolate milk

Colored butter

Beverages

Cider

Wine

Beer

Diet drinks

Tea, hot or cold

All carbonated beverages except 7-Up

Miscellaneous

Sherberts, ices, gelatins, junkets, puddings with
artificial flavor or coloring

Powdered pudding, jello, and drink mixes

All desert mixes

All manufactured candy - hard or soft

Oleomargarine

Prepared mustard

All mint flavored and wintergreen flavored items

Gum

Oil of wintergreen

Cloves

Jam or jellies made with artificial colors or flavors and
fruits not allowed

Soy sauce, if flavored or colored

Cider vinegar

Wine vinegar

Commercial chocolate syrup

Barbecue flavored potato chips

Catsup

Chili sauce

Sundry Items

Aspirin, Bufferin, Excedrin, Alka-Seltzer, Empirin,
Empirin Compound, Anacin

Vitamins

All toothpastes and toothpowder

All mouthwashes

All coughdrops

All throat lozenges

Antacid tablets

Perfumes

APPENDIX B
DESCRIPTION OF SUBJECTS

Subject K is an eight year old female Caucasian who has demonstrated a history of hyperactivity and learning problems. She has been in her present home environment, living with an aunt, for a period of approximately two and one-half years. Prior to this time, she lived with her natural parents in what was described as a very impoverished environment. Psychostimulant medication was prescribed as a treatment for K's hyperactivity, but her aunt decided against placing K on medication. The Feingold K-P diet was tried as an alternative treatment approach and K had been on the diet for a period of 11 months immediately prior to the start of this study.

Subject L is an eight year old female Caucasian who has demonstrated a history of hyperactivity, but very few learning problems. Her inappropriate behavior has manifested itself in the social domain rather than the academic. L lives with both parents in a middle class environment, with one parent holding a professional position and an advanced graduate degree. Psychostimulant medication was prescribed as a treatment approach for L's hyperactive behavior. Ritalin, at varying doses, was used as a pharmacological behavior modifier for a period of approximately three and one-half years before L was placed on the K-P

diet, at which time Ritalin was discontinued. At the beginning of the study, L had been on the K-P diet for a period of approximately 15 months.

APPENDIX C
COOKIE RECIPE

1 cup sweet butter or shortening
1 cup white sugar
1 cup brown sugar
1 teaspoon pure vanilla
2 eggs
2 cups sifted flour
1/2 teaspoon soda
1 teaspoon baking powder
1/4 teaspoon salt
2 cups oatmeal

Cream butter and add all other ingredients. Mix well.
Drop from the end of a teaspoon onto a well-greased baking sheet.
Bake in a 325° oven for 15 minutes. Yield: about 150 small
cookies.

Sweet butter is suggested because other butter may be dyed.
Crisco or other shortening may be substituted.

APPENDIX D
DRUG CHECKLIST

Name:

Date:

Please list any drugs that your child has taken in the past week.

PRESCRIBED MEDICATION

	<u>Drug</u>	<u>Dosage</u>	<u>Date Taken</u>
1.			
2.			
3.			
4.			
5.			

OVER-THE-COUNTER MEDICATIONS

	<u>Drug</u>	<u>Dosage</u>	<u>Date Taken</u>
1.			
2.			
3.			
4.			
5.			

INJECTIONS

	<u>Drug</u>	<u>Dosage</u>	<u>Date Taken</u>
1.			
2.			
3.			

DRUG CHECKLIST REPORTS

Subject: K

<u>Week</u>	<u>Drug</u>	<u>Dosage</u>
1	None	N/A
2	None	N/A
3	None	N/A
4	None	N/A
5	None	N/A
6	None	N/A

Subject: L

1	None	N/A
2	None	N/A
3	None	N/A
4	Penicillin	1 tablet, pediatric strength
	Alka Seltzer (without aspirin)	1 tablet in a glass of water
5	None	N/A
6	None	N/A

APPENDIX E
PARENT'S LOG

DATE:

COOKIE EATEN?

_____ Yes

_____ No

COMMENTS:

DATE:

COOKIE EATEN?

_____ Yes

_____ No

COMMENTS:

DATE:

COOKIE EATEN?

_____ Yes

_____ No

COMMENTS:

SUMMARY OF PARENT LOGS

Subject: K

<u>Date</u>	<u>Comment</u>
5-5-77	Tried to give her tomatoes in spaghetti sauce. Very hyper.
5-9-77	Spent weekend at the beach. Kate some candy. Seemed more hyper tonight.
5-18-77	Spent the night at a friend's house. Ate Shake and Bake for dinner.
5-19-77	Was very hyper tonight.
5-21-77	Gave her prune juice tonight

There were no other comments on this log.

Subject: L

5-2-77	L ate some candy, we think.
5-13-77	No school.
5-16-77	Field trip to Santa Fe Community College. Began swimming lessons today. Very excited.
5-17-77	Very hyper.
5-23-77	L came home from school very hyper. Had a very bad evening.
5-24-77	Good day.
5-25-77	Came home from school upset. Not a very good evening.
5-26-77	Fair day.
5-27-77	Good day.

5-30-77

Good day.

5-31-77

Good day.

There were no other comments on this log.

APPENDIX F
BEHAVIOR RECORDING FORM

Subject: _____ Time Began: _____
 Date: _____ Time End: _____
 Session: _____ Total Minutes: _____
 TIME BLOCK: _____

OUT OF SEAT

Count

Duration

: _____	: _____
: _____	: _____
: _____	: _____

OFF TASK

Duration

: _____	: _____	: _____	: _____	: _____
: _____	: _____	: _____	: _____	: _____

PHYSICAL AGGRESSION

Count

APPENDIX G
VARIABILITY ENVELOPES

Subject: L

<u>Behavior</u>	<u>Duration Ranges Within Phases</u>			
	<u>B1</u>	<u>B2</u>	<u>A</u>	<u>1st A</u>
On Task	.525-.836	.547-.760	.207-.655	.261-.470
Out of Seat	.100-.287	.130-.327	.333-.527	.405-.493

	<u>Frequency Ranges Within Phases</u>			
Out of Seat	.200-.367	.267-.433	.433-.867	.611-.867
Physical Aggression	0-.167	0-.067	0-.100	0-0

Subject: K

<u>Behavior</u>	<u>Duration Ranges Within Phases</u>			
On Task	.838-.916	.764-.939	.454-.799	.454-.760
Out of Seat	.013-.070	.004-.059	.140-.409	.140-.409

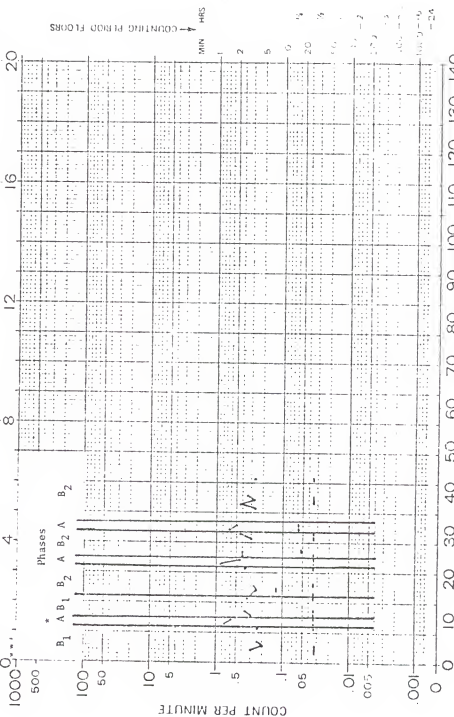
	<u>Frequency Ranges Within Phases</u>			
Out of Seat	.100-.160	.067-.233	.200-.433	.200-.433
Physical Aggression	0-.067	0-0	0-0	0-0

APPENDIX H

GRAPHIC DISPLAYS OF DATA

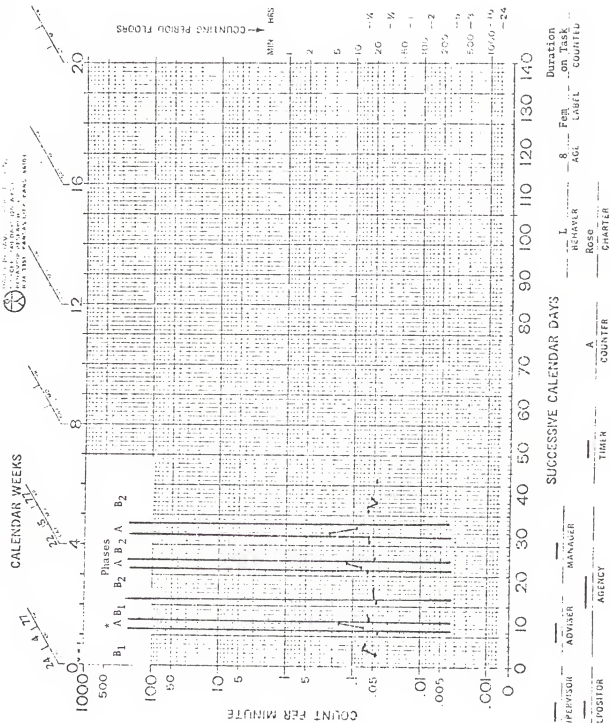
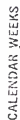
CALENDAR WEEKS

10% OF TOTAL COUNTS OF BEHN
INTERFERED BY
HUMAN FACTORS TO
BE EXCLUDED FROM
COUNTING PERIOD FLOORS

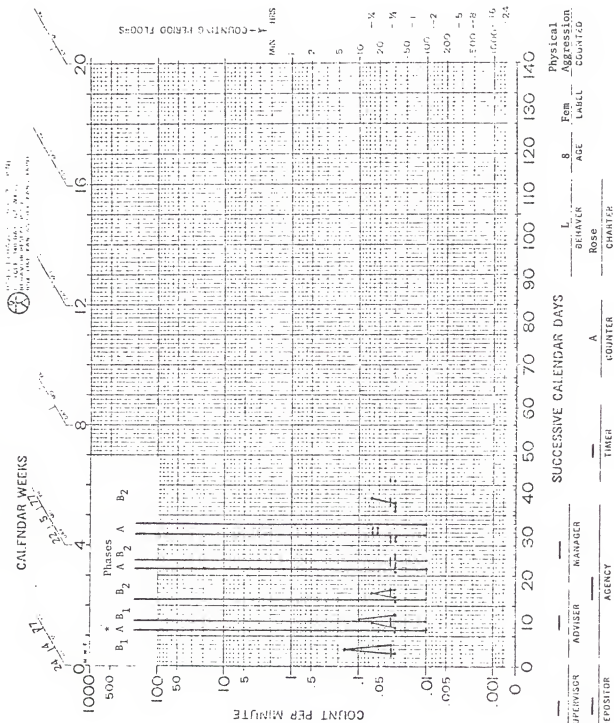


SUPERVISOR	ADVISER	MANAGER	BEHAVIOR	AGE	FEM	Out of Seat
DEPOSITOR	AGENCY	COUNTY	Rose	CHARACTER	LABEL	COUNTED

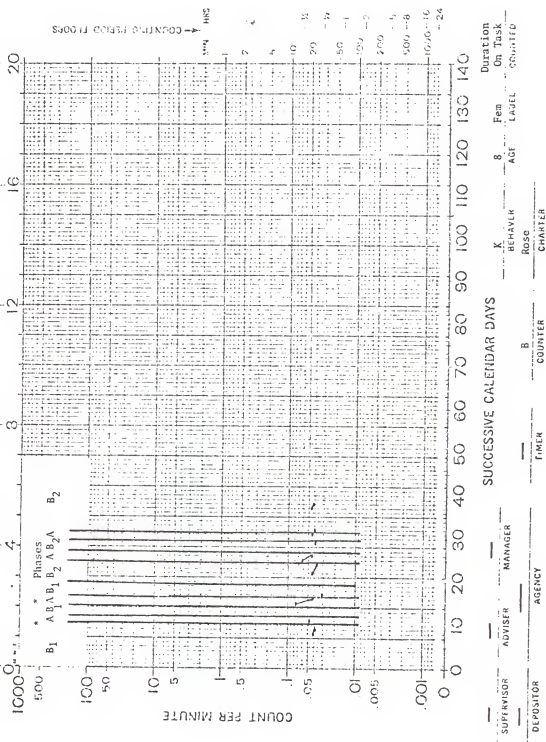
*Dietary Infraction



*Dietary Infraction

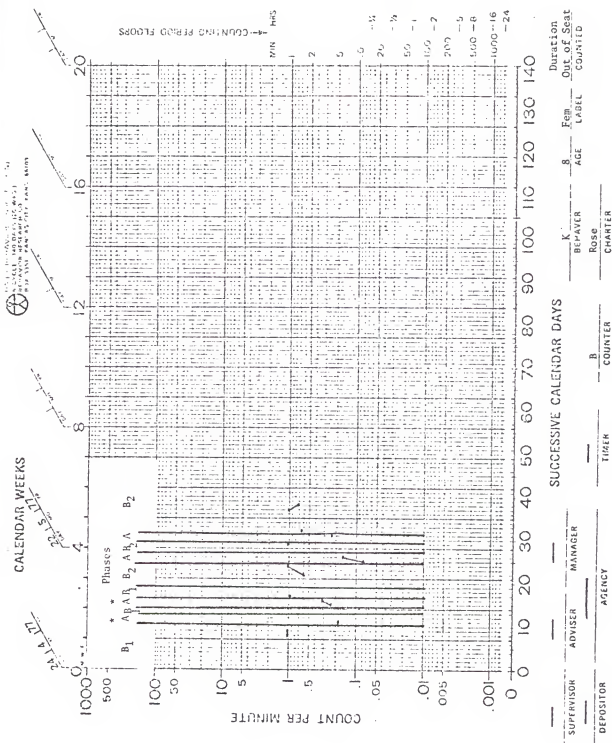


*Dietary Infraction



*Dietary Infraction

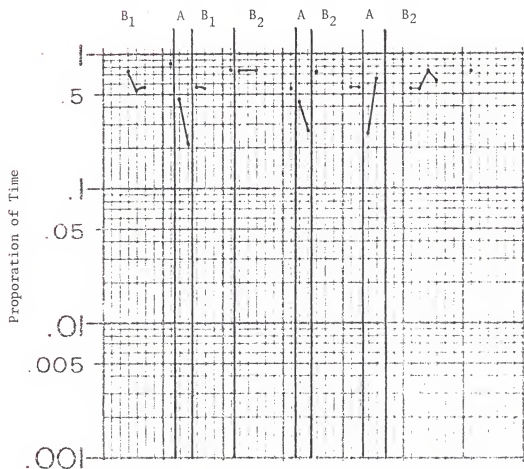




*Dietary Infraction

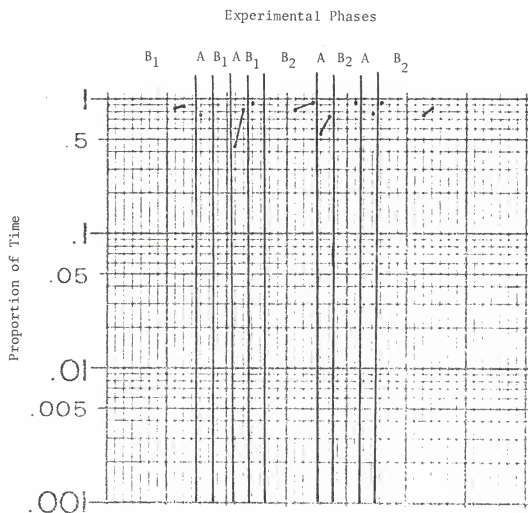


Experimental Phases



Behavior: L

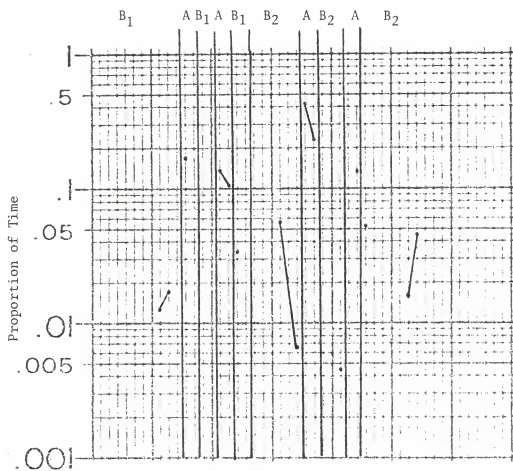
Movement: Duration on Task



Behavior: K

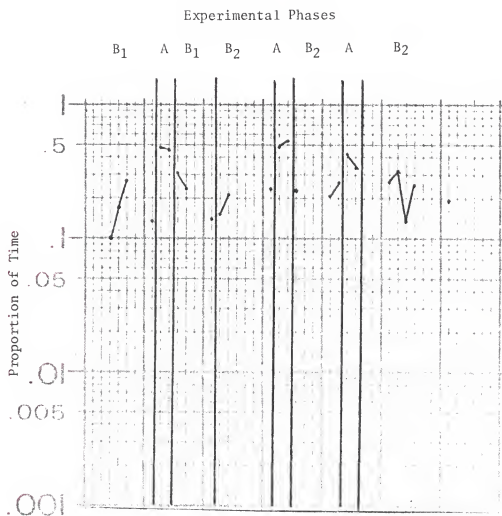
Movement: Duration on Task

Experimental Phases



Behavior: K

Movement: Duration out of seat



Behavior: L

Movement: Duration out of seat

APPENDIX I

RAW DATA

SUBJECT K

<u>Date</u>	<u>Out of Seat</u> <u>Count</u>	<u>Duration</u>	<u>Off Task</u>	<u>On Task</u>	<u>Physical</u> <u>Aggression</u>
4-27 W	-----		No Chance	-----	
4-28 R	-----		No Chance	-----	
4-29 F	-----		No Chance	-----	
5-2 M	3	0.24	4.38	25.13	2
5-3 T	4	0.31	2.65	26.70	0
5-4 W	-----		Ignored	-----	
5-5 R	6	5.30	1.93	22.80	0
5-6 F	-----		No Chance	-----	
5-9 M	6	4.20	12.16	13.63	0
5-10 T	5	3.10	2.20	24.68	0
5-11 W	3	1.01	1.50	27.48	0
5-12 R	-----		No Chance	-----	
5-13 F	-----		No Chance	-----	
5-16 M	7	1.76	3.48	24.75	0
5-17 T	-----		Ignored	-----	
5-18 W	3	0.20	.10	28.17	0
5-19 R	13	12.28	1.50	16.20	0
5-20 F	8	6.51	1.01	22.46	0
5-23 M	2	0.13	2.00	27.86	0
5-24 T	-----		No Chance	-----	
5-25 W	7	4.22	1.80	23.98	0
5-26 R	3	1.53	1.10	27.33	0
5-27 F	-----		No Chance	-----	
5-30 M	-----		No Chance	-----	
5-31 T	2	0.50	6.57	22.93	0
6-1 W	3	1.33	3.33	25.33	0

SUBJECT L

<u>Date</u>	<u>Out of Seat</u>		<u>Off Task</u>	<u>On Task</u>	<u>Physical Aggression</u>
	<u>Count</u>	<u>Duration</u>			
4-27 W	9	3.00	5.07	21.93	0
4-28 R	6	5.62	8.62	15.76	5
4-29 F	7	8.60	4.55	16.80	1
5-2 M	7	3.78	1.15	25.07	0
5-3 T	22	14.80	.56	14.10	0
5-4 W	18	13.80	10.00	6.20	2
5-5 R	10	9.05	3.35	17.60	3
5-6 F	11	6.63	6.70	16.67	0
5-9 M	10	4.10	2.38	23.50	0
5-10 T	9	4.56	2.60	22.80	0
* 5-11 W	2	I	I	I	2
5-12 R	8	6.10	1.20	22.70	0
5-13 F	----- NO CHANCE -----				
5-16 M	11	7.10	6.40	16.40	0
5-17 T	26	14.77	2.28	12.95	0
5-18 W	13	15.80	6.01	8.15	0
5-19 R	12	6.65	1.61	21.70	0
** 5-20 F	8	I	I	I	0
5-23 M	9	6.08	6.35	17.56	0
5-24 T	13	8.20	4.25	17.50	0
*** 5-25 W	11	7.30	5.90	4.71	0
*** 5-26 R	9	6.00	.22	11.80	0
5-27 F	----- NO CHANCE -----				
5-30 M	8	8.55	4.80	16.65	0
5-31 T	13	9.80	3.61	16.58	0
6-1 W	8	3.90	3.96	22.13	0
6-2 R	10	8.03	3.68	18.28	2
6-3 F	----- NO CHANCE -----				
6-6 M	8	5.98	2.00	22.01	0

* - Record Floor = 8 min. for Out of Seat; 30 min. for Phys. Aggress.

** - Record Floor = 20 min. for Out of Seat and Phys. Aggress.

*** - Record Floor = 18 min. for all measures

BIOGRAPHICAL SKETCH

Terry Rose was born in 1947 at Washington, D.C. After four months he and his family moved to Florida where they have lived since that time.

After graduating, in 1965, from Boca Ciega High School in St. Petersburg, Florida, he enrolled in St. Petersburg Junior College (SPJC) to pursue, what was at that time, a rather un-directed college education. During his stay at SPJC at least two important milestones in his life occurred. In 1968, he was married to the former Gail E. Tasney and in 1970, their first child, Regan, was born.

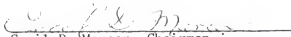
After graduating from SPJC in 1971, Mr. Rose enrolled in the University of South Florida, from which he received his Bachelor of Arts in Special Education (mental retardation) in 1973. In 1973, he entered graduate school at the University of Florida. After serving as a diagnostic-prescriptologist in the area of emotional disturbances for the Marion County, Florida, school system, he completed the requirements for the Master of Education degree in August, 1974. Again, his area of study was special education, but with an emphasis in emotional disturbance.

Mr. Rose then taught for two years in the Alachua County schools in Gainesville, Florida. During this time he was a resource teacher for emotionally disturbed elementary school children.


In January, 1975, he began studies for the Ph.D. in special education with an emphasis in specific learning disabilities. A much more important event also occurred in January, 1975; the birth of the Rose's second child, Randy. In 1976, Mr. Rose was employed as an instructor for the Career Associate in Special Education program at Santa Fe Community College in Gainesville, Florida.

Mr. Rose will complete the requirements for the degree of Doctor of Philosophy in August, 1977. He has accepted a position as an assistant professor of special education at the University of Northern Illinois in DeKalb, Illinois.

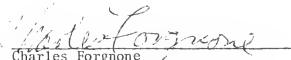
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.


Cecil D. Mercer, Chairman
Associate Professor of Special
Education

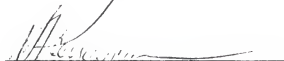
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.


Robert F. Algozzine
Assistant Professor of Special
Education

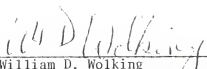
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.


Charles Forgnone
Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.


Henry S. Pennybacker
Professor of Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.



William D. Wolking
Professor of Special Education

This dissertation was submitted to the Graduate Faculty of the Department of Special Education in the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 1977

Dean, Graduate School